SUBSTITUTE FORM PTO-1390 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
12816-025001

U.S. APPLICATION NO. (If Known, see 37 CFR 1.5)
09/914417

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/00625	1 March 2000	1 March 1999

TITLE OF INVENTION
NON-LINEAR ECHO CANCELLATION IN DISCRETE MULTI-TONE SYSTEMS

APPLICANT(S) FOR DO/EO/US
Dietmar Straussnigg and Manfred Kogler

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern other documents or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
    - ☒ International Search Report
    - ☒ International Preliminary Examination Report
    - ☐
    - ☐
    - ☐

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August 28, 2001 — Samantha Bell — Samantha Bell

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U.S. APPLICATION NO. (If known) 09/914417	INTERNATIONAL APPLICATION NO. PCT/DE00/00625	ATTORNEY'S DOCKET NUMBER 12816-025001

17. ☒ The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)- (5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO..... **$1000**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... **$710**

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)..... **$690**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100**

	CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of **$130** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$0.00	

Claims	Number Filed	Number Extra	Rate		
Total Claims	22 - 20 =	2	x **$18**	$36.00	
Independent Claims	4 - 3 =	1	x **$80**	$80.00	
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ **$270**	$0.00	
TOTAL OF ABOVE CALCULATIONS =				$0.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$0.00	
SUBTOTAL =				$976.00	
Processing fee of **$130** for furnishing the English Translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f))				$0.00	
TOTAL NATIONAL FEE =				$976.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$0.00	
TOTAL FEES ENCLOSED =				$976.00	
				Amount to be refunded:	$
				Charged:	$

a. ☒ A check in the amount of $976.00 to cover the above fees is enclosed.
b. ☐ Please charge my Deposit Account No. 06-1050 in the amount of $0.00 to cover the above fees. A duplicate copy of this sheet is enclosed.
c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1050. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b) must be filed and granted to restore the application to pending status.

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41,942
REGISTRATION NUMBER

09/914417

Attorney's Docket No.: 12816-025001 / S1184 SB/flu

518 Rec'd PCT/PTO 28 AUG 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Dietmar Straussnigg	Art Unit	: Unknown
Serial No.	: Unknown	Examiner	: Unknown
Filed	: Herewith		
Title	: NON-LINEAR ECHO CANCELLATION IN DISCRETE MULTI-TONE SYSTEMS		

BOX PCT
Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Prior to examination, please amend the application as follows:

In the claims:

Please amend claim 1-7, 9 and 11 as follows:

1. **(Amended)** A circuit arrangement for two-wire/four-wire conversion in a DMT system, which is connected to a digital reception path, a digital transmission path and also an analog transmission/reception path and which has an echo cancellation device in the time domain, the arrangement having a device for adaptation of the echo cancellation in the frequency domain, wherein the echo cancellation device is nonlinear; and the device for adaptation of the echo cancellation has a first linear model, a nonlinear model and also a second linear model; and the coefficients of the nonlinear model which are determined in the device for adaptation of the echo cancellation can be transferred to a nonlinear unit of the echo cancellation device.

2. **(Amended)** The circuit arrangement as claimed in claim **1**, wherein the device for adaptation of the echo cancellation carries out the adaptation by means of a pilot tone.

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August 28, 2001
Date of Deposit

Samantha Bell
Signature

Samantha Bell
Typed or Printed Name of Person Signing Certificate

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3. **(Amended)** The circuit arrangement as claimed in claim **1**, wherein the first linear model and the second linear model of the device for adaptation of the echo cancellation are in each case formed by a complex number.

4. **(Amended)** The circuit arrangement as claimed in claim **1**, wherein the nonlinear model of the device for adaptation of the echo cancellation is formed by a Taylor series.

5. **(Amended)** The circuit arrangement as claimed in claim **4**, wherein the Taylor series of the nonlinear model is calculated up to the quadratic element.

6. **(Amended)** The circuit arrangement as claimed in claim **1**, wherein a linear echo cancellation device in the frequency domain is connected in parallel with the device for adaptation of the echo cancellation.

7. **(Amended)** A method for attenuating echo signals in a circuit arrangement for two-wire/four-wire conversion of a signal generated by multicarrier modulation with orthogonal subchannels, the modeling being effected in the frequency domain of the signal, while the echo cancellation is effected in the time domain of the signal, wherein the echo cancellation device is nonlinear; and the device for adaptation of the echo cancellation has a first linear model, a nonlinear model and also a second linear model; and the coefficients of the nonlinear model which are determined in the device for adaptation of the echo cancellation are transferred to a nonlinear unit of the echo cancellation device.

9. **(Amended)** The method as claimed in claim **7**, wherein the nonlinearities are mapped by a Taylor series.

11. **(Amended)** The method as claimed in claim **7**, wherein linear echo compensation is carried out in the frequency domain of the signal.

Please consider the following new claims 12-17 and 18-22.

12. **(New)** A circuit arrangement for echo cancellation in a DMT system, the circuit arrangement comprising:

a nonlinear device for adaptive echo cancellation in the frequency domain, the nonlinear device being connected between a digital reception path and a digital transmission path of the DMT system and having

first and second linear models, and

a nonlinear model configured to determine coefficients for adaptive echo cancellation; and

an echo-cancellation device having a nonlinear unit in communication with the nonlinear model of the nonlinear device for receiving the coefficients therefrom.

13. **(New)** The circuit arrangement as claimed in claim **12**, wherein the nonlinear device further comprises an input for receiving a pilot tone.

14. **(New)** The circuit arrangement as claimed in claim **12,** wherein the first linear model and the second linear model of the nonlinear device are configured to generate signals representative of first and second complex numbers.

15. **(New)** The circuit arrangement as claimed in claim **12**, wherein the nonlinear model of the nonlinear device is configured to generate a signal by evaluating a Taylor series.

16. **(New)** The circuit arrangement as claimed in claim **15**, wherein the nonlinear model of the nonlinear device is configured to generate a signal by evaluating a Taylor series truncated after a quadratic term thereof.

17. **(New)** The circuit arrangement as claimed in claim **12**, further comprising a linear echo cancellation device in the frequency domain connected between the digital transmission path and the digital reception path of the DMT system.

18. **(New)** A method for attenuating an echo of a signal generated by multicarrier modulation with orthogonal subchannels, said method comprising:

in the frequency domain of the signal, adaptively generating a nonlinear model of the signal; and

on the basis of the nonlinear model, performing nonlinear echo cancellation of the signal in the time domain of the signal;

19. **(New)** The method as claimed in claim **18**, wherein adaptively generating a nonlinear model comprises receiving a pilot tone.

20. **(New)** The method as claimed in claim **18**, wherein adaptively generating a nonlinear model comprises evaluating a Taylor series.

21. **(New)** The method as claimed in claim **20**, wherein evaluating the Taylor series comprises evaluating the Taylor series truncated after a quadratic term thereof

22. **(New)** The method as claimed in claim **18**, further comprising performing linear echo compensation in the frequency domain of the signal.

REMARKS

Applicant amends the claims of the PCT application to eliminate multiple dependencies and references to parts in the drawings. Applicant also submits new claims to encompass additional aspects of the invention described in the specification. No new matter is introduced.

Now pending in this application are apparatus claims 1-6 and 12-17, and method claims 7-11 and 18-22. Of these, claims 1, 7, 12, and 18 are independent. Applicant requests examination of all claims.

Excess claim fees are included with the filing fee of this application. Thus, no additional fees are believed to be due in connection with this preliminary amendment. However, to the extent that additional fees are due, or that a refund is forthcoming, please adjust our deposit account 06-1050.

Respectfully submitted,

Date: August 28, 2001

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Version with markings to show changes made

In the claims:

Claims 1-7, 9 and 11 have been amended as follows:

1. **(Amended)** A circuit arrangement for two-wire/four-wire conversion in a DMT system, which is connected to a digital reception path [~~(1)~~], a digital transmission path [~~(2)~~] and also an analog transmission/reception path [~~(3)~~] and which has an echo cancellation device [~~(12)~~] in the time domain, the arrangement having a device [~~(20)~~] for adaptation of the echo cancellation in the frequency domain, wherein the echo cancellation device is nonlinear; and the device [~~(20)~~] for adaptation of the echo cancellation has a first linear model [~~(21)~~], a nonlinear model [~~(22)~~] and also a second linear model [~~(23)~~]; and the coefficients of the nonlinear model which are determined in the device [~~(20)~~] for adaptation of the echo cancellation can be transferred to a nonlinear unit [~~(14)~~] of the echo cancellation device [~~(12)~~].

2. **(Amended)** The circuit arrangement as claimed in claim 1, [~~one of the preceding claims,~~] wherein the device [~~(20)~~] for adaptation of the echo cancellation carries out the adaptation by means of a pilot tone.

3. **(Amended)** The circuit arrangement as claimed in claim 1, [~~either of claims 1 and 2,~~] wherein the first linear model [~~(21)~~] and the second linear model [~~(23)~~] of the device [~~(20)~~] for adaptation of the echo cancellation are in each case formed by a complex number.

4. **(Amended)** The circuit arrangement as claimed in claim 1, [~~one of claims 1-3,~~] wherein the nonlinear model [~~(22)~~] of the device [~~(20)~~] for adaptation of the echo cancellation is formed by a Taylor series.

5. **(Amended)** The circuit arrangement as claimed in claim 4, wherein the Taylor series of the nonlinear model [~~(22)~~] is calculated up to the quadratic element.

6. **(Amended)** The circuit arrangement as claimed in claim 1, [~~one of the preceding claims,~~] wherein a linear echo cancellation device [~~(18)~~] in the frequency domain is connected in parallel with the device [~~(20)~~] for adaptation of the echo cancellation.

7. **(Amended)** A method for attenuating echo signals in a circuit arrangement for two-wire/four-wire conversion of a signal generated by multicarrier modulation with orthogonal subchannels, the modeling being effected in the frequency domain of the signal, while the echo cancellation is effected in the time domain of the signal, wherein the echo cancellation device is nonlinear; and the device [~~(20)~~] for adaptation of the echo cancellation has a first linear model [~~(21)~~], a nonlinear model [~~(22)~~] and also a second linear model [~~(23)~~]; and the coefficients of the nonlinear model which are determined in the device [~~(20)~~] for adaptation of the echo cancellation are transferred to a nonlinear unit [~~(14)~~] of the echo cancellation device [~~(12)~~].

9. **(Amended)** The method as claimed in claim 7, [~~either of claims 7 and 8,~~] wherein the nonlinearities are mapped by a Taylor series.

11. **(Amended)** The method as claimed in claim 7, [~~one of claims 7-10,~~] wherein linear echo compensation is carried out in the frequency domain of the signal.

Description

1/prts

Circuit arrangement for two-wire/four-wire conversion in a DMT system with nonlinear echo cancellation

The present invention relates to a circuit arrangement for two-wire/four-wire conversion in a DMT system in accordance with the preamble of claim 1, as disclosed in EP-A-0 498 369.

US-A-3,647,992 discloses a circuit arrangement for two-wire/four-wire conversion in a DMT system, which is connected to a digital reception path, a digital transmission path and also an analog transmission/reception path and which has nonlinear echo cancellation in the time domain and also has a device for adaptation of the nonlinear echo cancellation in the frequency domain.

US-A-5,778,055 discloses nonlinear echo cancellation in connection with an analog telephone system.

US 5,317,596 describes a method and a device for echo cancellation in the case of a signal generated by discrete multitone modulation. As is known, full-duplex data transmission is the simultaneous transmission of data in two opposite directions with partly overlapping frequency bands. In this case, an echo occurs as a result of a signal to be transmitted crossing into the receiver situated at the same location, as a result of which a signal received by the remote end is superposed and corrupted. By way of example, an echo occurs in a telephone network if the signal transmitted by a user passes through the hybrid circuit into the receiver of the user. This hybrid circuit may also be referred to as an echo channel. Such an echo channel can be modeled by a finite number of parameters. Therefore, an echo canceler first estimates the parameters and then linearly convolves the estimation with the transmitted signal, as a result of which the echo is emulated. The emulated echo signal thus obtained is then subtracted from the received signal, whereby the pure signal is produced in the ideal case.

Echo principally occurs owing to inexactly matched impedances at the hybrid connectors. Since the impedances of the transmission lines are time-dependent and line-dependent, the echo canceler must be adaptive. Furthermore, it is possible to carry out echo cancellation both in the time domain and in the frequency domain of a signal.

In multicarrier modulation, the data to be transmitted are transmitted by the binary digital data that are to be transmitted first being arranged in sub-blocks. These sub-blocks are then combined to form blocks of fixed length which are then in each case modulated onto a carrier and transmitted. Discrete multitone modulation is a form of multicarrier modulation which is used in digital signal processing, an IFFT/FFT pair being used as modulation/demodulation vector.

In the US patent specification mentioned, the echo cancellation is performed both in the time domain and in the frequency domain of a signal. What is disadvantageous is that only linear echo cancellation is performed, so that complete echo cancellation is not achieved.

Furthermore, methods are known in which the cancellation of the nonlinear echo signal is effected in the time domain and the attenuation of the linear echo signal is preferably effected in the frequency domain. This gives rise to difficulties in the adaptation due to slow transient recovery and convergence problems.

Furthermore, WO 98/32241 describes a circuit arrangement for two-wire/four-wire conversion, in which digital signals of a digital reception path are converted and coupled via a hybrid onto an analog transmission/reception path and analog signals of the analog transmission/reception path are digitized and coupled onto a digital transmission path, echo suppression being connected between the digital transmission and reception paths. In this case, an echo estimation filter is used to adaptively approximate the behavior of the hybrid circuit and of the analog transmission/reception path. In this case, the echo cancellation is effected both in the frequency domain

and in the time domain of the signals, which causes difficulties in the adaptation.

The invention is based on the object, therefore, of developing effective echo cancellation in systems with multicarrier modulation with orthogonal subchannels.

The object is achieved by means of the features of the device according to claim 1 and of the method according to claim 9. The subclaims relate to the preferred refinements of the invention.

In the invention's method and device for attenuating nonlinear echo signals in a circuit arrangement for two-wire/four-wire conversion with multicarrier modulation with orthogonal subchannels, for example "Discrete Multitone Modulation" (DMT), "Orthogonal Frequency Division Multiplex" (OFDM) or "Discrete Wavelet Multitone" (DWMT), the modeling of the nonlinearities is effected in the frequency domain of a signal, while the nonlinear echo cancellation is effected in the time domain of the signal.

A pilot tone is used for adaptation of the nonlinear modeling. The nonlinearities of the transmission system, in particular of the line driver, cause harmonics, i.e. frequencies at even-numbered multiples of the fundamental frequency occur. Furthermore, said fundamental frequency is altered in magnitude and phase via the linear echo path.

In the frequency domain of the signal, the modeling of nonlinearities is composed of a linear part and a nonlinear part, the linear part, since only the pilot tone is used, being reduced to complex number a1 (magnitude and phase), or, since two linear models are necessary, to two complex numbers a1 and a2. The

nonlinear model is described by the dependence of fundamental relative to the respective harmonics.

The adaptation is effected by means of an error signal composed of the difference between the received signal and the estimated echo. In this case, firstly the linear model and then the nonlinear model are adapted. The nonlinear model can be approximated by a Taylor series. In this case, the Taylor series is preferably terminated after the quadratic element.

The coefficients of the nonlinear model are then transferred to the nonlinear time model.

Figure 1 shows a circuit diagram of echo cancellation according to the invention.

Via a digital reception path 1, the signal passes via an IFFT 4 (Inverse Fast Fourier Transformation), a D/A converter 5, a filter 6, a line driver 7 into the hybrid or echo path 8 and onto an analog transmission/reception path 3. A received analog signal passes via a filter 9, an A/D converter 10, an FFT 11 (Fast Fourier Transformation) onto the digital transmission path 2.

In the echo path or hybrid 8, an echo of the digital transmission signal passes into the reception path of the digital transmission signal, is added to the analog reception signal and therefore leads to interference.

For cancellation of the echo signal, a nonlinear echo canceler 12 comprising a first filter 13, a nonlinear unit 14 and a second filter 15 is provided in the time domain, i.e. downstream of the IFFT 4 and upstream of the FFT 11, of the circuit arrangement. Furthermore, the nonlinear echo canceler 12 has an adder 16, in which the signal downstream of the first filter 13 is

subtracted from the signal downstream of the nonlinear unit 14. The cancellation signal, i.e. the estimated echo, is subtracted from the analog signal comprising the reception signal and the echo in a further adder 17.

Furthermore, the circuit has a linear echo canceler 18 in the frequency domain, i.e. upstream of the IFFT 4 and downstream of the FFT 11, whose estimated echo signal is subtracted, in an adder 19, from the digitized signal comprising the reception signal without the nonlinear echo component.

For adaptation of the nonlinear echo canceler 12, the circuit has a device 20 for adaptation of the nonlinearities, which comprises a first linear model 21, a nonlinear model 22 and a second linear model 23, the pilot tone being fed to the device 20. The first and second linear models 21, 23 are adapted by means of an error signal which, in an adder 24, is composed of the estimated echo and the reception signal with the linear echo component. The nonlinear model is adapted by means of an error signal which, in a further adder 25, is composed of the estimated echo and the reception signal. The coefficients of the nonlinear model 14 are transferred to the nonlinear unit 14 of the nonlinear echo canceler 12.

Patent claims

1. A circuit arrangement for two-wire/four-wire conversion in a DMT system, which is connected to a digital reception path (1), a digital transmission path (2) and also an analog transmission/reception path (3) and which has an echo cancellation device (12) in the time domain, the arrangement having a device (20) for adaptation of the echo cancellation in the frequency domain, wherein the echo cancellation device is nonlinear; and the device (20) for adaptation of the echo cancellation has a first linear model (21), a nonlinear model (22) and also a second linear model (23); and the coefficients of the nonlinear model which are determined in the device (20) for adaptation of the echo cancellation can be transferred to a nonlinear unit (14) of the echo cancellation device (12).

2. The circuit arrangement as claimed in one of the preceding claims, wherein the device (20) for adaptation of the echo cancellation carries out the adaptation by means of a pilot tone.

3. The circuit arrangement as claimed in either of claims 1 and 2, wherein the first linear model (21) and the second linear model (23) of the device (20) for adaptation of the echo cancellation are in each case formed by a complex number.

4. The circuit arrangement as claimed in one of claims 1-3, wherein the nonlinear model (22) of the device (20) for adaptation of the echo cancellation is formed by a Taylor series.

5. The circuit arrangement as claimed in claim 4, wherein the Taylor series of the nonlinear model (22) is calculated up to the quadratic element.

6. The circuit arrangement as claimed in one of the preceding claims, wherein a linear echo cancellation device (18) in the frequency domain is connected in parallel with the device (20) for adaptation of the echo cancellation.

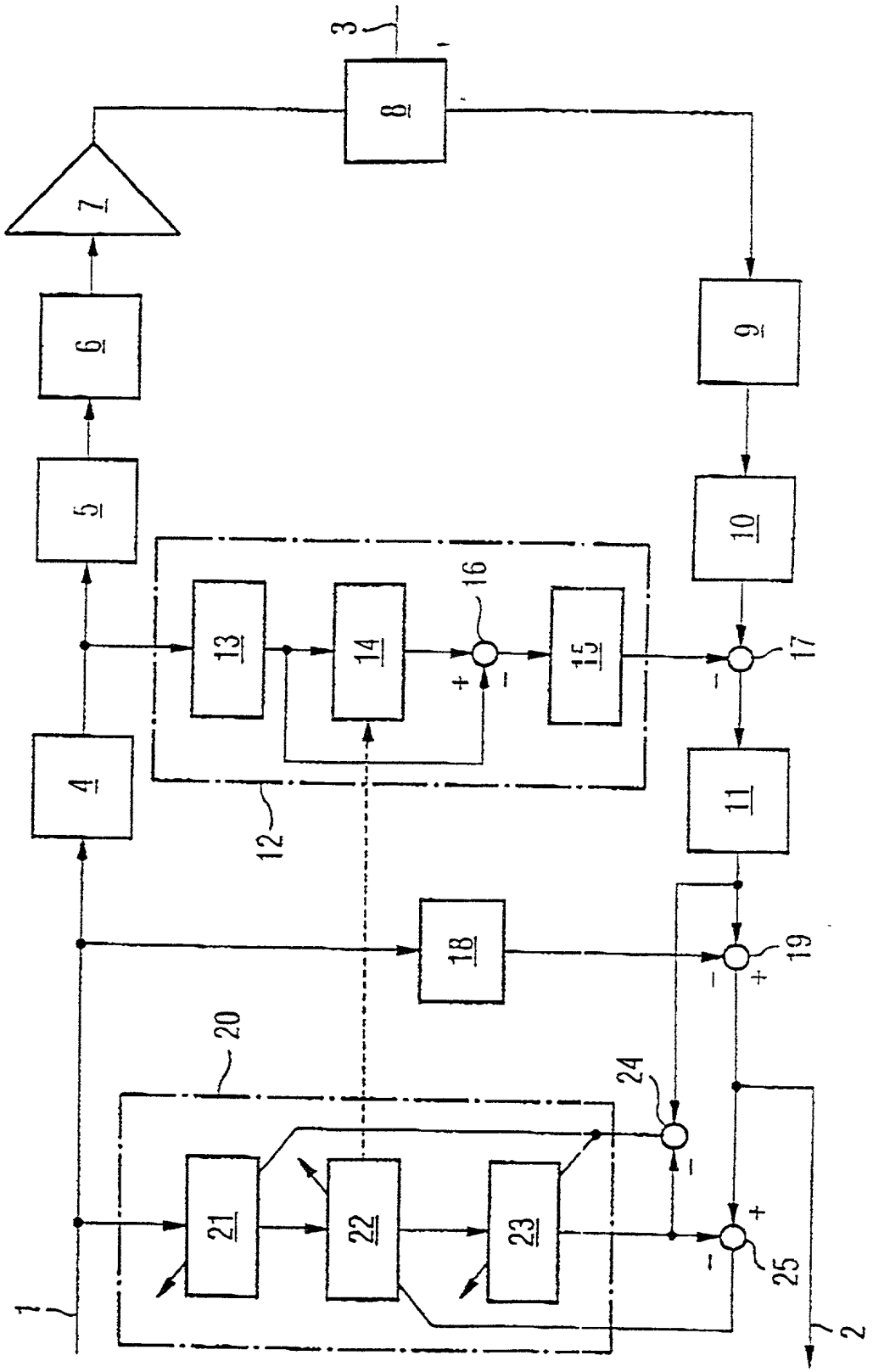
7. A method for attenuating echo signals in a circuit arrangement for two-wire/four-wire conversion of a signal generated by multicarrier modulation with orthogonal subchannels,
the modeling being effected in the frequency domain of the signal, while the echo cancellation is effected in the time domain of the signal, wherein the echo cancellation device is nonlinear; and the device (20) for adaptation of the echo cancellation has a first linear model (21), a nonlinear model (22) and also a second linear model (23); and the coefficients of the nonlinear model which are determined in the device (20) for adaptation of the echo cancellation are transferred to a nonlinear unit (14) of the echo cancellation device (12).

8. The method as claimed in claim 7, wherein the modeling of the nonlinearities is effected using a pilot tone.

9. The method as claimed in either of claims 7 and 8, wherein the nonlinearities are mapped by a Taylor series.

10. The method as claimed in claim 9, wherein the Taylor series is terminated after the quadratic element.

11. The method as claimed in one of claims 7-10, wherein linear echo compensation is carried out in the frequency domain of the signal.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Attorney's Docket No.: 12816-025001
Client's Ref. No.: S1184 SB/flu

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled NON-LINEAR ECHO CANCELLATION IN DISCRETE MULTI-TONE SYSTEMS, the specification of which:

[] is attached hereto.
[X] was filed on August 28, 2001 as Application Serial No. 09/914,417 and was amended on _____.
[] was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim the benefit under Title 35, United States Code, §119(e)(1) of any United States provisional application(s) listed below:

U.S. Serial No.	Filing Date	Status
DE 199 08 814.4	March 1, 1999	Pending
PCT DE00/00625	March 1, 2000	Pending

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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Boston, Massachusetts 02110-2804

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Combined Declaration and Power of Attorney

1-00

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Inventor's Signature: _____ Date: 07.11.2001

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Citizenship: Austria

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Full Name of Inventor: MANFRED KOGLER

Inventor's Signature: _____ Date: _____

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Citizenship: AT

Post Office Address: Annabichlerstr.21, 9500 Villach, Austria

Attorney's Docket No.: 12816-025001
Client's Ref. No.: S1184 SB/flu

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled NON-LINEAR ECHO CANCELLATION IN DISCRETE MULTI-TONE SYSTEMS, the specification of which:

[] is attached hereto.
[X] was filed on August 28, 2001 as Application Serial No. 09/914,417 and was amended on _____.
[] was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim the benefit under Title 35, United States Code, §119(e)(1) of any United States provisional application(s) listed below:

U.S. Serial No.	Filing Date	Status
DE 199 08 814.4	March 1, 1999	Pending
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

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